Technical Guideline: Voice over LTE (VoLTE) for IoT

Version: 1.0

Introduction

This document outlines the technical specifications for the use of the Voice over LTE (VoLTE) service by Internet of Things (IoT) terminals operating specifically on the Telefónica Germany network. It is intended to guide IoT device manufacturers and service providers in configuring and verifying VoLTE functionality. It also identifies features that are disabled, unsupported, or not applicable to the IoT environment, helping ensure that device implementations align with the relevant IMS specifications and requirements. Where configuration options depend on network deployment or subscription profiles, the applicable settings should be confirmed with Telefónica Germany. Requirements that use the terms "SHALL" or "SHALL NOT" are mandatory and must be fulfilled to ensure the proper compatibility and interoperability of the VoLTE service. Requirements containing "SHOULD" or "SHOULD NOT" indicate recommended practices that are advised but are not strictly compulsory. As a disclaimer, since there is no home-routing, IoT Device vendors would need to implement different VoLTE configurations depending on the visited network(s).

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Telefónica Germany VoLTE platform description

Telefónica Germany operates its VoLTE service for IoT using a distributed IP Multimedia Subsystem (IMS) architecture, with the Proxy-Call Session Control Function (P-CSCF) and Policy and Charging Rules Function (PCRF) hosted in Germany, while the Interrogating and Serving Call Session Control Functions (I-CSCF and S-CSCF), IP Short Message Gateway (IP-SM-GW), and Telephone Number Mapping (ENUM) components are hosted by Telefónica Tech in Spain. At present, the IoT VoLTE service is available within the Telefónica Germany domestic network and supports outbound roaming through partner networks. Currently, there is no support on the Telefónica Germany network for VoLTE services over a 3GPP LTE-M access bearer.

Three different Telefónica Germany connectivity (SIM) profiles are enabled on the Telefónica Germany IoT VoLTE platform:

- Telefónica Germany International Profile: MCC 901, MNC 85;
- Telefónica Germany Local Profile: MCC 262, MNC 03; and
- Telefónica Germany Local Profile: MCC 262, MNC 07.

The Telefónica Germany Global Profile (MCC 214, MNC 07) interoperates with a different IMS stack. Please contact Telefónica Germany for the respective technical guidelines.

International and Global Profiles are always treated as roaming profiles, including when connected to the Telefónica Germany network. A domestic connection is only possible when a Telefónica Germany Local Profile is used within the operator's own network.

Supported Procedures

The following functionalities are supported by Telefónica Germany's VoLTE service:

- LTE Attach using Data APN and IMS APN;
- IMS registration;
- Call barring;
- Mobile-originated VoLTE calls; and
- Mobile-terminated VoLTE calls.

The following features are not supported by Telefónica Germany's VoLTE service:

- SRVCC, i.e., a handover from VoLTE to circuit-switched (CS) call;
- Supplementary Service configuration via XCAP/Ut;
- Voice over WiFi (VoWiFi) as defined in [3GPP TS 23.402];
- Video over LTE (ViLTE) as defined in [GSMA PRD IR.94];
- Real-Time Text (RTT) It is covered by [3GPP TS 26.114], Section 5.2.3 and Section 7.4.4, with the VoLTE implementation profile defined in [GSMA IR.92];
- Unstructured Supplementary Service Data (USSD) over IMS (USSI, i.e., dial strings); and
- Local short codes.

Furthermore, Voice over New Radio (VoNR), the 5G equivalent of VoLTE, is not supported by the Telefónica Germany IoT IMS architecture.

APN Usage

For IoT VoLTE, the LTE attachment process consists of two distinct steps:

1. Initial LTE attachment: During the initial attachment to the LTE network, the IoT device SHALL specify the default Data APN (iot.telefonica.de) or customer-specific APN, with the ESM flag set to 1. This corresponds to the APN configured for the relevant SIM profile within Telefónica Germany's Home Subscriber Server (HSS).
2. IMS connectivity and VoLTE registration: Once the initial LTE attachment is complete, the IoT device SHALL establish a Packet Data Network (PDN) connection using the designated IMS APN. This connection is required to register for VoLTE services processed in the separate IMS core. The IMS APN is also configured in the same HSS profile associated with the SIM.

Please note that the IoT APN must be different from the IMS APN in the HSS profile.

Handling of Emergency Calls

There are several emergency call types specified for IoT customers:

- Public emergency calls;
- eCalls (automotive customers);
- Local emergency calls (a country-specific emergency number); and
- Private emergency calls (a normal VoLTE call to a third-party emergency service).

Please note that VoLTE emergency calls do not use digits like "112" or "911." An IoT device SHALL send an SOS URN (various formats) to signal an emergency call.

The IoT VoLTE platform does not support public emergency calls or eCalls directly. When an IoT device is connected to the Telefónica Germany home network, these calls are handled by the operator's core network. Both services may be established through either the circuit-switched (CS) domain or the VoLTE domain. IoT devices

capable of supporting both technologies can determine the appropriate domain based on specific network-provided indications.

The Telefónica Germany IoT VoLTE platform also currently does not support local emergency numbers. This limitation also includes the rejection of emergency calls that are not recognized by the platform, which are responded to with a SIP 380 (Alternative Service) message. The primary use case for emergency calling within the Telefónica Germany IoT VoLTE environment is private emergency communication.

Network Access

The following requirements define the capabilities necessary to establish a secondary IMS APN for VoLTE services. IoT device manufacturers and service providers deploying these devices are responsible for ensuring that VoLTE-capable IoT devices connected to the Telefónica Germany network can successfully establish the required IMS connectivity and access VoLTE services.

VoLTE APN

When attaching to the LTE network, the VoLTE-capable device SHALL follow the procedure outlined below:

- The LTE Attach APN SHALL be stored in the device's internal APN configuration, for example, within the SIM profile;
- During the initial LTE Attach procedure, the IoT device SHALL request the LTE Attach APN specified in its internal configuration; and
- Following the initial attachment, the IoT device SHALL establish an additional PDN connection using the IMS APN in accordance with [IR.92], provided that the IMS APN differs from the LTE Attach APN. As defined in [IR.92], the standard IMS APN is "ims".

Blank APN Name

If no APN is designated as the LTE Attach APN in the device's internal APN configuration, the IoT device SHALL request the initial default PDN connection with an empty APN value (i.e., APN = ""). In the Telefónica Germany network (HPLMN) the network will assign the default IoT APN (iot.telefonica.de) or the customer-specific APN instead.

Use of IMS APN for SIP Signaling

The IoT device SHALL use the IMS well-known APN "ims" for SIP signaling, in accordance with [IR.92], Section 4.3.1, [IR.51], Section 4.6, and [IR.88].

PDN Connection Handling

If the initial Attach procedure establishes a PDN connection using an APN other than the IMS well-known APN, the IoT device SHALL establish an additional PDN connection to the IMS APN, in accordance with [IR.92], Section 4.3.1.

The device SHALL request IPv4v6 as the PDN type for this secondary connection, as specified in [IR.92], Section 5.1.

EPS Bearer Configuration

The IoT device SHALL manage EPS bearers for VoLTE in accordance with the procedures specified in [IR.92], Section 4.3, as outlined below:

- The default bearer with QCI 5 is used for SIP signaling;
- The dedicated bearer with QCI 1 is used for voice and the bearer setup is initiated by the network.

EPS Mobility Management Compliance

The IoT device SHALL comply with the EPS Mobility Management procedures defined in 3GPP TS 24.301 Release 19, in particular Sections 4.3, 5.5.1 and 5.5.3. Device behavior during LTE Attach, Tracking Area Update (TAU),

and related mobility management procedures SHALL remain compliant with these specifications unless explicitly superseded by requirements defined in this guideline.

P-CSCF Discovery & Handling

The IoT device SHALL support P-CSCF discovery through the Protocol Configuration Options (PCO) Information Element (IE) during EPS procedures, as specified in [IR.92], Section 4.4.

When requesting default connectivity, the IoT device SHALL include the P-CSCF IPv6 Address Request and P-CSCF IPv4 Address Request parameters, where applicable. These requests SHALL also be included when establishing a PDN connection to the IMS APN. If the same P-CSCF address is received more than once, the most recently received address SHALL take precedence.

If no P-CSCF address is provided following the establishment request for the IMS APN PDN connection, the IoT device SHALL NOT attempt IMS registration with any P-CSCF. In this situation, the device SHALL NOT initiate another Attach procedure solely to obtain a P-CSCF address.

Device Configuration for Access Domain Selection

The IoT device SHALL enable the Mobility_Management_IMS_Voice_Termination parameter to support the network-based terminating access domain selection procedure, in accordance with [3GPP TS 24.167], Section 5.31.

SIP Attach Configuration

When initiating a PDN Connectivity Request for VoLTE, the IoT device SHALL set the IM CN Subsystem Signaling Flag to indicate that the connection is intended for SIP signaling, in accordance with [3GPP TS 24.229], Annex L.2.2.1.

SIP Registration & Attach

The following requirements specify the capabilities necessary for IoT devices to attach to the network and register for VoLTE services. IoT device manufacturers and service providers deploying these devices are responsible for ensuring that VoLTE-enabled IoT devices operating on the Telefónica Germany network can successfully complete the required attachment and registration procedures.

IMS Profile for Voice and SMS

The IoT device SHALL comply with the applicable requirements of [3GPP TS 24.229] (Release 10) and the GSMA PRD [IR.92], *IMS Profile for Voice and SMS*, from Version 11.0 and later.

TCP Maximum Segment Size

The IoT device SHALL configure the TCP Maximum Segment Size (MSS) to a value below 1340 bytes for all IMS services to ensure that the Maximum Transmission Unit (MTU) does not exceed 1500 bytes.

SIP Registration to IMS

The IoT device SHALL initiate IMS registration for VoLTE, including the MMTEL ICSI, when the network indicates IMS VoIP support in its response to the Attach procedure, as specified in [IR.92], Section 2.2.1. Signaling compression SHALL NOT be used during the initial IMS registration.

If a NOTIFY message contains the state attribute set to “terminated” and the event attribute set to “deactivated”, thereby triggering deregistration, the IoT device SHALL initiate a new IMS registration procedure in accordance with [3GPP TS 24.229], Section 5.1.1.7.

The “expires” parameter in the SIP REGISTER request SHALL be set on the IoT device to a value of at least 7200 seconds.

Contents of Registration Request

The SIP REGISTER request SHALL include the following information:

- MMTel IMS Communication Service Identifier (ICSI): The request SHALL contain the MMTel ICSI value urn:urn-7:3gpp-service.ims.icsi.mmtel, as specified in [IR.92], Section 2.2.1; and
- Contact address Instance ID: The +sip.instance parameter in the Contact header field SHALL include the device's IMEI-based URN, in accordance with [IR.92], Section 2.2.1.

Note: Unless registration is required for another applicable service, the IoT device SHALL NOT initiate IMS registration under other circumstances. Registration for additional services SHOULD be performed whenever necessary.

User Agent Header

The IoT device SHOULD support the SIP User-Agent header, which contains a unique identifier composed of the device name and software ID. An operator variant ID SHOULD be included in this header.

Registration Features

The IoT device SHALL support the following IMS registration-related features:

- Registration event subscription: Support subscription to the registration event package, in accordance with [IR.92], Section 2.2.1.
- Network-initiated deregistration: Support deregistration initiated by the network, as specified in [IR.92], Section 2.2.1.
- P-Access-Network-Info header: Support the P-Access-Network-Info header in accordance with [3GPP TS 24.229]. The header SHALL include the access network type and cell identifier, using the E-UTRAN Cell Global Identifier (ECGI).

Handling of an "Interval Too Brief" Response to an Initial Registration Request

If the IoT device receives a SIP 423 (Interval Too Brief) response to a REGISTER request, it SHALL retransmit the REGISTER request with the registration expiration interval set to a value equal to or greater than the minimum interval specified in the Min-Expires header of that SIP 423 response.

Handling of "Service Unavailable" or "Retry-After" Responses to an Initial Registration Request

If the IoT device receives a SIP 503 (Service Unavailable) response, or any other SIP 4xx, 5xx, or 6xx response containing a "Retry-After" header, it SHALL automatically retry the initial IMS registration once the interval specified in the Retry-After header has elapsed. The retry SHALL be performed using the same IP Connectivity Access Network (IP-CAN) and the same Proxy-Call Session Control Function (P-CSCF).

Support for SIP Re-registration

The IoT device SHALL perform IMS re-registration before the current registration expires or when triggered by a service-specific event, such as deregistering one service while maintaining registration for other services. During the re-registration, the IoT device SHALL verify the network's IMS VoIP support indication in the Attach and SHALL register for VoLTE services only if the network indicates that IMS voice services are supported.

Re-registration if PDN Connection Lost

If the PDN connection is lost, the IoT device SHALL verify the network's IMS VoIP support indication and attempt to restore VoLTE service only if IMS voice support is indicated, in accordance with [IR.92], Section 2.4.2.1. If connectivity is successfully restored, the IoT device SHALL perform an IMS re-registration only if its IP address has changed or the existing IMS registration has expired.

SIP de-Registration Procedures

The IoT device SHALL de-register from IMS when the final active IMS service requests a deregistration or when the underlying access technology changes, for example, from LTE to 3G/2G.

Procedures for IMS Restoration

In accordance with [3GPP TS 24.229], if the IoT device receives no response from the initially selected P-CSCF before Timer F expires during initial registration, re-registration, or de-registration, it SHOULD initiate a new initial registration attempt using an alternative P-CSCF address.

Handling of "Unauthorized" Challenges

In accordance with [3GPP TS 24.229], the IoT device SHALL process a SIP 401 (Unauthorized) response received during re-registration or de-registration using the same authentication procedures applied to a challenge received during an initial registration.

Handling of "Server Time-Out" Response

In accordance with [3GPP TS 24.229], if the IoT device receives a SIP 504 (Server Time-Out) response to any request other than REGISTER, such as an INVITE request, it SHALL initiate a new initial IMS registration procedure.

Handling of "Modify EPS Bearer Context Request" Message

In accordance with Section L.2.2.1C of [3GPP TS 24.229] Release 9 and Section 4.4 of [IR.92], the IoT device SHALL initiate a new initial IMS registration if it receives a "Modify EPS Bearer Context Request" containing a list of P-CSCF addresses that excludes the address of the currently selected P-CSCF.

If such a request is received while a call is in progress, the IoT device SHALL defer the new initial registration until the ongoing call has ended.

Call Functionality & Features

The following requirements define the capabilities necessary to establish and conduct VoLTE calls after successful network registration. IoT device manufacturers and service providers deploying these devices are responsible for ensuring that VoLTE-capable IoT devices operating on the Telefónica Germany network can successfully execute the specified procedures.

IP Versions

The IoT device SHALL support both IPv4 and IPv6 across all IMS-related protocols.

Authentication

The IoT device SHALL implement IMS Authentication and Key Agreement (IMS-AKA) using a SIM profile, in accordance with the requirements specified in [IR.92], Section 2.2.2.

Encryption Algorithms

The IoT device SHALL support Security Agreement (Sec-Agree) and IPsec. The list of proposed IPsec encryption algorithms SHALL include the null encryption algorithm in all cases, as Telefónica Germany may select null encryption for debugging purposes.

MSISDN-based IMPU

The IoT device SHALL support an IMS Public User Identity (IMPU) based on the Mobile Subscriber ISDN Number (MSISDN). This configuration includes a telephone URI (tel-URI) and its corresponding SIP URI; the Telefónica Germany network supports correct routing for both URI formats. Below are examples of how this could look like:

tel: +491234567890

SIP:+491234567890@ttech.ims.mnc003.mcc262.3gppnetwork.org; user=phone

(OR)

SIP:+491234567890@ttech.ims.mnc007.mcc262.3gppnetwork.org; user=phone

(OR)

SIP:+491234567890@ttech.ims.mnc085.mcc901.3gppnetwork.org; user=phone

IMS Profile for Voice and SMS

All chapters of GSMA PRD [IR.92], *IMS Profile for Voice and SMS*, from Version 11.0 and later, SHALL be implemented, with the exception of Annex B and Section A.3.

Indication of Send/Recv Media

In the Session Description Protocol (SDP) offer included in the initial INVITE request, the IoT device SHALL specify a bidirectional media direction (send/receive) either explicitly by including the a=sendrecv attribute or implicitly by omitting the media direction attribute, in accordance with [IR.92], Section 2.2.4.

SIP Preconditions

The Telefónica Germany network currently does not support SIP Preconditions.

That said, it is recommended that the IoT device SHOULD implement the SIP precondition framework and apply preconditions appropriately during call establishment, in accordance with [IR.92], Section 2.4.1, [3GPP TS 24.229], and the signaling procedures outlined in [3GPP TR 24.930].

When preconditions are applied to an outgoing INVITE request, the IoT device SHOULD advertise support for them using the Supported header rather than the Require header. Furthermore, the IoT device SHOULD NOT assume that the network or called party IoT device supports or applies preconditions, as specified in [IR.92], Section 2.4.1.

Invitation Requests without Preconditions

In accordance with [IR.92], Section 2.4.1, upon receiving an INVITE request that does not contain preconditions, the IoT device SHALL respond with a SIP 183 (Session Progress) message containing the P-Access-Network-Info (PANI) header and an SDP body. The device SHALL alert the user and send a SIP 180 (Ringing) response once the terminating side has successfully reserved the required local resources.

Identification Presentation and Restriction

The IoT device SHALL implement Originating Identification Presentation (OIP), Terminating Identification Presentation (TIP), Originating Identification Restriction (OIR), and Terminating Identification Restriction (TIR) in accordance with the requirements defined in [IR.92].

Displaying Caller Identity

When a P-Asserted-Identity header is present, the IoT device SHALL use its value to identify and display the calling party, disregarding the From header field. If the P-Asserted-Identity header is absent, the IoT device SHALL use the value of the From header field to display the caller's identity.

Playing Ring-back Tone

The IoT device SHALL support the P-Early-Media header in accordance with [IR.92], [RFC 5009], and [3GPP TS 24.229]. During call establishment, the device SHALL play any early media received from the network, including ring-back tones and announcements. If no early media is received, the device SHALL generate a local ring-back tone, triggered by the receipt of a SIP 180 (Ringing) response.

The Telefónica Germany IoT VoLTE stack currently does not support network-based ring-back tones and call-setup announcements using standardized early-media procedures. Nevertheless, the feature may be implemented in the future, if any need arises. The P-Early-Media header is used to indicate whether early media is to be received by the IoT device. When the header indicates that network-provided early media is available, the device SHALL play the received media. Otherwise, it SHALL provide a locally generated ring-back tone.

Ringing / Ring-back Timers

The IoT device SHALL implement a terminal-based originating-call setup timer of 130 seconds. If the outgoing call has not been answered before timer expiry, the device SHALL terminate the call attempt in accordance with applicable IMS/SIP procedures.

The IoT device SHALL implement a terminal-based incoming-call alerting timer of 130 seconds. If the incoming call has not been answered before timer expiry, the device SHALL stop alerting and release the call in accordance with applicable IMS/SIP procedures.

The 130-second value is a proposed device requirement, not a universal 3GPP-mandated value. The timers SHOULD operate independently of network-side timer configuration, while still respecting network-initiated call release and applicable SIP procedures.

Invitation and Re-invitation Requests

The IoT device SHALL accept INVITE and re-INVITE requests that contain unsupported media types by setting the port number to zero in the corresponding media lines of the generated SDP answer.

If the IoT device receives a re-INVITE request without an SDP offer, it SHALL generate and include an SDP offer in the next reliable response, such as a SIP 200 OK response, in accordance with [RFC 3261].

Note: Telefónica Germany's VoLTE service uses re-INVITE requests without SDP offers to support third-party call control procedures, for example, when placing a call on hold to play announcements or manage RTCP-related functions.

Remote end Updating of Media

The IoT device SHALL support media session updates initiated by the remote endpoint through SIP re-INVITE or UPDATE requests, including changes to the remote media IP/port. Although currently not supported by the Telefónica Germany IoT VoLTE stack, a potential future use case would be the establishment of an ad hoc multiparty conference, during which the network may modify the media path.

“Busy Here” Response

In accordance with [IR.92], when the IoT device is unable or unwilling to answer an incoming call because the user is already engaged in another call or has rejected the call, it SHALL respond with SIP 486 (Busy Here).

When the IoT device receives a SIP 486 (Busy Here) or SIP 603 (Decline) response, it SHOULD play an appropriate locally generated tone to indicate that the call was rejected or the called party is busy.

Loss of Dedicated Media Bearer for Voice

In accordance with [IR.92], if the IoT device loses the dedicated EPS bearer used for voice media, it SHALL terminate the associated SIP session locally.

“Bye” Handling

When terminating a call session by sending a SIP BYE request, the IoT device SHOULD include an appropriate Reason header field in accordance with [RFC 3326].

Session Description Protocol Capability Negotiation

The IoT device SHALL NOT implement Session Description Protocol Capability Negotiation (SDPcapNeg). However, in accordance with [IR.92], it SHALL be capable of ignoring SDPcapNeg attributes received from the remote endpoint.

Voice Codecs

In accordance with [IR.92], the IoT device SHALL support the Adaptive Multi-Rate (AMR) narrowband codec and the Adaptive Multi-Rate Wideband (AMR-WB) codec, including all available codec modes for both.

Acoustic Characteristics

The IoT device SHALL meet the minimum performance requirements for jitter buffer management and acoustic characteristics specified in [IR.92].

Enhanced Voice Service (EVS) Modes

In accordance with [IR.92], the IoT device SHOULD support the Enhanced Voice Services (EVS) codec, including the following capabilities:

- NB-SWB modes: Support for EVS Narrowband to Super-wideband modes at bitrates of up to 24.4 kbps;
- AMR-WB interoperability: Support for the EVS AMR-WB Interoperability (IO) mode, including the payload format specified in [3GPP TS 26.445] and frame interworking in accordance with [RFC 4867]; and
- Channel-Aware mode: Support for operation at 13.2 kbps for both Wideband and Super-wideband audio bandwidths, as specified in [3GPP TS 26.445] and [3GPP TS 26.114].

EVS Audio Bandwidth

For EVS Primary mode, the IoT device SHOULD include the “bw” parameter in the SDP to specify the supported audio bandwidth, as defined in [3GPP TS 26.445], covering bandwidths from Narrowband to Super-wideband. The default parameter value specified in [IR.92], Section C.3, SHOULD be applied.

EVS RTP Payload Format

The IoT device SHOULD support both the Compact and Header-Full formats for the EVS RTP payload, in accordance with [3GPP TS 26.445].

RTCP Handling

The IoT device SHALL support reception of all RTCP packet types. It SHOULD also transmit RTCP packets during early media, active calls, and call-hold periods, in accordance with GSMA [IR.92], Version 10 and later.

RTP Handling

The IoT device SHALL use the same port number for transmitting and receiving RTP packets, and likewise use the same port number for transmitting and receiving RTCP packets. However, it SHALL NOT assume that the remote endpoint follows the same port allocation behavior.

DTMF Handling

In accordance with [IR.92], the IoT device SHALL support the transmission and reception of Dual-Tone Multi-Frequency (DTMF) events.

Circuit-Switched Fallback due to Call Set-up Failure

For IoT device applications that support 2G (GSM) and/or 3G (UMTS) access, if an IMS call attempt fails because no response is received to the INVITE request during session establishment, the IoT device SHALL initiate a circuit-switched (CS) call over the available 2G and/or 3G bearer within 5 seconds. It SHALL NOT wait for Timer A or Timer B, as specified in Table 7.8 of [3GPP TS 24.229], to expire before retrying the call, in accordance with [3GPP TS 24.173 V14.0.0].

After completing a CS call initiated due to the lack of a response to the INVITE request, the IoT device SHOULD return to 4G (LTE) and initiate a new IMS registration.

No Configuration via OMA DM

The IoT device SHALL operate without requiring configuration through Open Mobile Alliance Device Management (OMA DM). It SHALL support the default parameter settings defined for the IMS Management Object in the applicable standards, including [3GPP TS 24.167], [3GPP TS 24.229], [IR.92], and [IR.51].

Circuit-Switched Service and Fallback

The following requirements define the capabilities necessary to support circuit-switched (CS) procedures and Circuit-Switched Fallback (CSFB) to 2G voice. IoT device manufacturers and Service Providers deploying these

devices SHALL ensure that CS and CSFB functionalities are correctly configured and operate as intended on VoLTE-enabled IoT devices connected to the Telefónica Germany network.

Please note that all 2G services, including CSFB, will be discontinued for Telefónica Germany SIM profiles during the second half of 2028. For additional requirements concerning the 2G shutdown, please refer the corresponding section below.

Request Rejection if Speech Media Not Supported

In accordance with [IR.92], Section A.2, the IoT device SHALL reject incoming call requests if speech media cannot be supported over the currently active packet-switched (PS) access.

Handling of Voice Calls with no VoLTE Subscription Available

If a VoLTE-capable IoT device does not have an active VoLTE subscription, the Telefónica Germany network will reject its attempt to establish a connection to the well-known IMS APN. In this situation, the IoT device SHALL use circuit-switched (CS) or circuit-switched fallback (CSFB) procedures to establish voice calls.

If the IoT device is not registered with IMS, for example, due to a failed initial registration or re-registration attempt, it SHOULD use the CS domain or CSFB for voice calls whenever available.

All applicable IMS-standard procedures SHALL still be supported, regardless of whether CS is used for voice communication. These procedures include handling specific error responses, such as SIP 500 (Server Internal Error) and SIP 503 (Service Unavailable) containing a Retry-After header, as well as P-CSCF restoration procedures.

Initiation of CS Call whenever IMS Call Fails

In accordance with [IR.92] Version 11, Annex A.2, if an IMS call attempt fails and the IoT device receives a SIP 500 (Server Internal Error) response, it SHOULD retry the call using the circuit-switched (CS) domain.

Initiation of CS Call whenever IMS Call Fails and CS access (GERAN, UTRAN) is available

If the IoT device switches from the packet-switched (PS) domain to the circuit-switched (CS) domain during call establishment for any reason, it SHALL cancel the ongoing IMS call setup before attempting the call over CS, provided that a provisional response to the initial SIP INVITE has already been received.

Device Configuration as "Voice centric"

The IoT device SHALL be configured for voice-centric operation, as specified in [3GPP TS 23.221]. The "Voice_Domain_Preference_E_UTRAN" parameter, defined in [3GPP TS 24.167], Section 5.27, SHALL be set to "IMS PS Voice preferred, CS Voice as secondary," in accordance with [3GPP TS 23.221].

Return to IMS after Fallback to CS Domain

If the IoT device falls back to the circuit-switched (CS) domain for voice calls, it SHOULD attempt to return to IMS whenever possible, for example, when returning to LTE coverage or after the next power cycle. Following the use of CS or CS fallback (CSFB) due to a temporary outage of Telefónica Germany's IMS network, the IoT device SHOULD resume IMS-based voice services once IMS connectivity becomes available.

Support for Idle Mode Signaling Reduction (ISR)

If the IoT device supports Idle Mode Signaling Reduction (ISR), its implementation SHALL comply with 3GPP Release 9, or higher. ISR enables the IoT device to remain registered with both UTRAN/GERAN and E-UTRAN, allowing reselection between LTE and 2G/3G without requiring periodic Tracking Area Update (TAU) and Routing Area Update (RAU) procedures.

For the purpose of Terminating Access Domain Selection (T-ADS), the IoT device SHALL disable ISR, in accordance with [IR.92], Section A.2, [3GPP TS 23.401], and [3GPP TS 24.301].

Circuit Switched Fallback (CSFB) Configuration

The IoT device SHALL be configured to support Circuit-Switched Fallback (CSFB) and SHALL perform a combined EPS/IMSI Attach when attaching to LTE. Please note that all 2G services will be discontinued for Telefónica

Germany SIM profiles during the second half of 2028, after which PS-only Attach SHOULD be used. Please refer to the chapter below corresponding to the 2G Sunset.

As an implementation optimization, if the initial Attach procedure uses a non-optimal method (i.e., either an EPS Attach or a combined EPS/IMSI Attach), the IoT device SHOULD store the outcome and use the alternative Attach procedure for subsequent Attach attempts on the same network, until the outcome changes. For example, if the IoT device initially performs a combined EPS/IMSI Attach and the network rejects the IMSI Attach because CS domain is not supported, the device SHOULD continue to use VoLTE and perform an EPS Attach directly during the next Attach procedure. Please note that using an EPS Attach hinders support for SMS service over Non-Access Stratum (NAS).

Emergency Calls

The following requirements specify the capabilities necessary to support regulatory emergency calling over VoLTE. IoT device manufacturers and Service Providers deploying these devices SHALL ensure that emergency calling functionality is correctly configured and operates as intended on all VoLTE-enabled IoT devices deployed on the Telefónica Germany network.

Pre-configured Emergency Numbers List

The IoT device SHALL support emergency numbers pre-configured on the SIM, in accordance with [IR.92], Section 5.2.1. Currently, both 112 and 911 are configured on the Telefónica Germany IoT SIM cards.

Updating Emergency Numbers List

The IoT device SHALL support Mobility Management procedures for updating the emergency number list, in accordance with [IR.92], Section 5.2.1.

Handling of Network-Provided Emergency Number List

The IoT device SHALL support reception of emergency number information provided by the network in accordance with 3GPP TS 24.301. Emergency numbers received from the network during LTE Attach, Tracking Area Update, or other applicable Mobility Management procedures SHALL supplement or update the locally configured emergency number list. The device SHALL use the resulting list for emergency call detection, domain selection, and emergency call establishment procedures.

Domain Selection & Placement of Emergency Call

In accordance with [IR.92], Section A.5, the IoT device SHALL be capable of detecting whether the network supports VoLTE emergency calls and SHALL support emergency call domain selection. If an emergency call fails in the selected domain, the IoT device SHALL attempt to establish the call using an alternative domain or other network, where available.

When initiating a VoLTE emergency call, the IoT device SHALL establish a connection to the emergency PDN, perform an emergency IMS registration, and establish the emergency session using that registration. The emergency registration SHALL include the device's IMEI, in accordance with [IR.92], Section 5.2.1.3.

Sending of Geolocation during an Emergency Session

When initiating an IMS emergency session, the IoT device SHOULD provide its location in the initial SIP INVITE request using the Geolocation header and a PIDF location object, in accordance with Sections 5.1.6.8.2 and 5.1.6.8.3 of [3GPP TS 24.229].

Emergency Registration Timer

If emergency IMS registration times-out, the IoT device SHOULD initiate an anonymous emergency call within 3 seconds, without waiting for Timer B or Timer F, as specified in Table 7.8 of [3GPP TS 24.229], to expire.

Emergency Registration Failure Handling

If emergency IMS registration fails due to an error response or times out, the IoT device SHALL initiate an anonymous emergency call in accordance with [3GPP TS 23.167] and [IR.92]. This requirement also applies to

scenarios in which a roaming device with a valid roaming agreement is successfully registered with its home IMS network but cannot complete emergency registration with the local IMS network.

Behavior when an IMS Emergency Registration is not Possible

If the IoT device cannot authenticate with the IMS network, for example, because an inbound roaming device has no valid roaming agreement, it SHALL NOT attempt IMS emergency registration. Instead, it SHALL immediately initiate an emergency session in accordance with [3GPP TS 23.167].

Emergency Call Set-up Timer

When sending an emergency SIP INVITE, the IoT device SHALL start a timer with a default value of 10 seconds. The timer SHALL be stopped upon receipt of a provisional SIP “18x” response. If the timer expires before such a response is received, the IoT device SHALL retry the emergency call over the circuit-switched (CS) bearer.

Emergency Call Failure Handling

If an IMS emergency call fails due to an error response or time out, the IoT device SHALL initiate an emergency call over the circuit-switched (CS) domain.

If the IoT device receives a SIP 380 (Alternative Service) response without emergency service information for an undetected emergency call (e.g., a call to 110 in Germany), and domain selection determines that the call SHALL be retried over the CS domain, the IoT device SHALL initiate a normal CS call rather than a CS emergency call.

VoLTE Roaming

The following requirements define the capabilities necessary to support VoLTE roaming. IoT device manufacturers and service providers deploying these devices are responsible for ensuring that VoLTE roaming is correctly configured and functions as intended when VoLTE-capable IoT devices connect to the Telefónica Germany network as visitors.

VoLTE Roaming

VoLTE roaming SHALL be supported by the IoT device. When roaming, if the Visited Public Land Mobile Network (VPLMN) provides a Voice over Packet-Switched (VoPS) indication during the LTE Attach procedure, the IoT device SHALL attempt to establish a PDN connection using the well-known IMS APN.

The visited Mobility Management Entity (MME) determines the applicable APN configuration based on the subscriber profile retrieved from the Home Public Land Mobile Network (HPLMN) HSS. This profile specifies whether IMS traffic is routed through the home network using S8 Home Routing (S8HR) or handled locally within the visited network via Local Breakout (LBO). Telefónica Germany uses the S8HR architecture for VoLTE roaming.

VoLTE Emergency Calls in Roaming

The IoT device SHALL support VoLTE emergency calls while roaming, with emergency sessions established through the visited network using Local Breakout (LBO). The device SHALL select the appropriate domain for an emergency call based on the emergency service support indication received from the visited network during the Attach procedure. Support for VoLTE emergency calling in roaming scenarios SHALL be configurable on the IoT device, allowing the feature to be enabled or disabled through a software update.

2G Sunset

The following requirements define considerations to be taken once the Telefónica Germany network completes its 2G Sunset during the second half of 2028. Suppliers are recommended to roll out these changes well in advance to avoid service interruptions or interoperability issues.

Acceptance of LTE Attach Response indicating "No CS Domain Available"

The IoT device SHALL accept an LTE Attach Accept message containing the Additional Update Result indication set to "No CS Domain Available". Reception of this indication SHALL NOT be treated as an Attach failure and SHALL NOT prevent the device from continuing LTE service operation.

Acceptance of EPS-only LTE Attach

When an LTE Attach procedure is successfully completed and the network indicates support for Voice over Packet-Switched (VoPS) services, the IoT device SHALL remain attached to LTE and SHALL continue to utilize LTE services. The device SHALL NOT abandon LTE service solely because circuit-switched voice service is unavailable.

Retention of LTE Capability following Attach or Tracking Area Update Failures

The IoT device SHALL NOT permanently disable LTE capability due to LTE Attach failures, Tracking Area Update failures, temporary radio coverage limitations, or poor signal conditions. The device SHALL continue LTE service acquisition and mobility management procedures in accordance with applicable 3GPP specifications.

Retention of LTE Service when IMS Voice is Unavailable

If IMS voice service is unavailable while LTE packet-switched service remains available, the IoT device SHALL maintain LTE connectivity and SHALL continue supporting packet-switched services. The unavailability of IMS voice service SHALL NOT result in the deactivation of LTE capability.

Acceptance of LTE Service without SRVCC Capability

The IoT device SHALL support LTE service operation in networks that do not support SRVCC. The absence of SRVCC capability SHALL NOT prevent LTE service operation and SHALL NOT be treated as a service failure condition.

EPS Mobility Management Compliance

The IoT device SHALL comply with the EPS Mobility Management procedures defined in 3GPP TS 24.301 Release 19, in particular Sections 4.3, 5.5.1 and 5.5.3, unless otherwise specified by requirements contained within this document.

IoT Device LTE Feature Group Indicator (FGI) Bits for VoLTE

The table below outlines the mandatory Feature Group Indicator (FGI) bit settings that an IoT device SHALL set to ON for FDD/TDD operation to ensure correct VoLTE operation on Telefónica Germany's radio access network.

Index (Bit Number)	Setting Name
3	5-bit RLC UM SN
	7-bit PDCP SN
7	RLC UM
9	EUTRA RRC_CONNECTED to GERAN GSM_Dedicated handover
23	GERAN measurements, reporting and measurement reporting event B2 in E-UTRA connected mode
28	TTI bundling

IoT Device VoLTE Settings

The following table provides an overview of the recommended configuration parameters for VoLTE operation on the Telefónica Germany network. It consolidates the settings required across several technical areas, including packet core connectivity, voice domain preferences, IMS security and authentication, mobility management,

supplementary services, SIP signaling, and media handling. Each entry specifies the applicable parameter and its expected value, together with additional notes where necessary to clarify implementation requirements or network-specific considerations.

Setting Name	Setting Value	Comments
Packet Core Network-related		
VoLTE APN	ims	
PDN type	IPv4v6	During packet-switched Attach for VoLTE, the IoT device requests the PDN type IPv4v6, as described in [IR.92], Section 5.1.
ESM Information Transfer Flag in LTE Attach Request	Dependent on Attach APN	Telefónica Germany deploys VoLTE with IPv6 and IPv4.
Combined EPS/IMSI Attach	Enabled	Once the 2G network is decommissioned at the end of 2028, only EPS Attach will be supported.
APN name for Emergency Call,	APN “sos” is assigned by network during emergency connectivity request; IP Type = IPv4v6	
VoLTE Voice Domain Preferences		
Voice Domain Preference for E-UTRAN	'00' - CS Voice only	Configuration for non-VoLTE IoT devices.
	‘11' - IMS PS voice preferred, CS Voice as secondary	Configuration for VoLTE IoT devices. CS Voice will not be supported once the 2G network is decommissioned at the end of 2028.
Mobility Management IMS Voice Termination	1 = Mobility Management for IMS Voice Termination enabled	Configuration for VoLTE IoT devices.
VoLTE Features		
IMS Video Telephony	Disabled	“Media_type_restriction_policy” (Voice and/or Video over LTE allowed), as per parameter in [IR.92], Section C.3.
IR.94 Version compliancy (e.g. IR.94v10.0; IR.94v11.0)	Not applicable	
ViLTE Codecs (e.g. H.264 CBP Level 1.2; H.264 CHP Level 3.1; H.265 (HEVC) Main Profile, Main Tier, Level 3.1)	Not applicable	
Upgrade from Voice to Video	Not applicable	
Downgrade from Video to Voice	Not applicable	
IMS Voice via HSPA	Disabled	
IoT device use of VoLTE Emergency Service	Enabled	
IoT device use of Emergency Service via VoWifi	Disabled	VoWiFi service is not supported in the IoT environment.
SRVCC to 2G	Disabled	SRVCC is not supported in IoT VoLTE environment.
SRVCC to 3G	Disabled	SRVCC is not supported in IoT VoLTE environment.
SRVCC for Emergency Session	Not applicable	Used only if VPLMN supports SRVCC. IMS emergency calls are handled by the visited network.
SRVCC in Alerting Phase	Disabled	SRVCC is not supported in IoT VoLTE environment.
bSRVCC	Disabled	SRVCC is not supported in IoT VoLTE environment.
MSC Server Assisted Mid-call Feature during Access Transfer	Disabled	
vSRVCC	Disabled	SRVCC is not supported in IoT VoLTE environment.
rSRVCC	Disabled	SRVCC is not supported in IoT VoLTE environment.
Early Media Support	Enabled	
DTMF Support	Enabled	According to [IR.92] v10 and later.

ViLTE Roaming	Disabled	Parameter name in [IR.92], Section C.3 = “Media_type_restriction_policy” (Voice and/or Video over LTE allowed while roaming).
Supplementary Services		
Supported Supplementary Services	Disabled	Supplementary Services are not supported in the IoT VoLTE environment.
Procedures for Consultative Transfer (ECT), as defined in [IR.92] v10 Section 2.3.11	Disabled	
Originator Information Restriction	Not applicable	
FromPreferred	Not applicable	
Security		
IMS Authentication Method	IMS-AKA with USIM	The IoT device supports IMS-AKA with USIM as described in [IR.92], Section 2.2.2.
Ut Authentication Method	Not Applicable	
GBA BSF Server URL	Derived from the IMPI or IMSI, according to [3GPP TS 23.003]	The GBA module calculates the BSF address from the IMSI parameters MCC and MNC; the FQDN to contact is of the format: bsf.mncXXX.mccYYY.pub.3gppnetwork.org
GBA Access Protocol and Port	Ub/HTTP -:80 and 8080 Ut/HTTP - :80 and 8080 Ut/HTTPS - :443	
IPSEC	Enabled	The device supports IPSec as described in [IR.92], Section 2.2.2.
IPSec Integrity Algorithms	HMAC_SHA2-256-128; HMAC_SHA1-96	List is offered within “sec agree”.
IPSec Encryption Algorithms (ESP)	AES-CBC-256, 3DES-CBC; AES-CBC; NULL	List is offered within “sec agree”.
Mobility		
Cell Reselection Idle, LTE to 2G	Enabled	The 2G network will be decommissioned at the end of 2028.
Cell Reselection Idle, 2G to LTE	Enabled	The 2G network will be decommissioned at the end of 2028.
Cell Reselection Connected, 2G to LTE	Enabled	The 2G network will be decommissioned at the end of 2028.
Packet Handover Connected, LTE to 2G	Disabled	The 2G network will be decommissioned at the end of 2028.
Packet Handover Connected, 2G to LTE	Disabled	The 2G network will be decommissioned at the end of 2028.
Configuration and Addressing		
P-CSCF Configuration and Discovery Method (e.g. PCO or SIM based)	Enabled	The IoT device supports P-CSCF discovery via EPS procedures
FQDN Support	Disabled	There is no FQDN support for P-CSCF discovery
Generic		
IR.92 Version Compliancy (e.g., [IR.92] v10.0; [IR.92] v11.0)	IR.92v10 and later	
Device Management Method (e.g. OTA, Auto configuration, SIM, manually, …)	Not applicable	Telefónica Germany offers no device management system for VoLTE.
GRUU Support	Disabled	
SIP Instance Support	Enabled, according to [IR.92], Section 2.2.1	
RegRetryBaseTime	30 seconds	
RegRetryMaxTime	1800 seconds	
Support of TEL URI / SIP URI	Both enabled	
Phone-context URI	According to [IR.92] v10 and later	
Policy_on_local_numbers	1 = home-local	This is the local number type for voice and video calls.
Precondition_disabling_policy	Enabled	SIP Preconditions are used.
Sigcomp (SIP Message Compression) support	Disabled	

SIP Timers T1, TA, TF, TB ([3GPP 24.229], Table 7.7.1)	Default values of [IR.92], Annex C3	
SIP Timers T2 ([3GPP 24.229], Table 7.7.1)	Default values of [IR.92], Annex C3	
SIP Timers T4, ([3GPP 24.229], Table 7.7.1)	Default values of [IR.92], Annex C3	
SIP Timers TA, TF, TB ([3GPP 24.229], Table 7.7.1)	Default values of [3GPP 24.229], Table 7.7.1	
Registration, Ringing, and Ringback Timers ([3GPP 24.229], Table 7.7.1)	Registration Timer = Standard; Ringing timer >= 130 seconds	
Session Expires Refresher Preference (UAS / UAC)	According to [IR.92] v10 Section 2.2.8	
Session Expires - Refresher Method (Invite / update)	Update	
Reliable 18x policy; Sending SIP 18x (other than SIP 183 Response) Reliably	0	Parameter name in [IR.92], Section C.3 = Reliable 18x policy Section 5.53 of [3GPP TS 24.167]. There are two possible values: • 0 – Indicates that the SIP 18x responses (other than SIP 183 response) are to be sent unreliably; and • 1 – Indicates that the SIP 18x responses (other than SIP 183 response) are to be sent reliably.
Default_EPS_bearer_context_usage_restriction_policy (Media on Default (QCI=5) Bearer)	voice:Prohibit video:Prohibit	Indicates whether the IoT device is allowed (or not) to send voice/video media over the default bearer of the PDN connection used by IoT device to access IM CN subsystem (globally or per IMS communication service).
Media		
RTCP	Enabled	RTCP transmission is used during active session and when the session is on hold.
Supported Codecs	AMR, AMR-WB, EVS	
octet-align	Excluded	Permissible values are 0 and 1.
RateSet for AMR	Excluded	If 1, octet-aligned operation is used.
RateSet for AMR-WB	Included	
EVS/Br	5.9-24.4	Parameter name in [IR.92], Section C.3 = RateSet for AMR.
EVS/Bw	nb-swb	If not present, all codec modes are allowed for the payload type.
ICM/INIT_PARTIAL_REDUNDANCY_OFFSET_RECV	0	Parameter name in [IR.92], Section C.3 = RateSet for AMR-WB.
mode-change-period	Excluded	If not present, all codec modes are allowed for the payload type.
mode-change-neighbor	Excluded	Parameter name in [IR.92], Section C.3 = EVS/Br.
Maxptime	240	Parameter name in [IR.92], Section C.3 = EVS/Bw.
Crc	Excluded	
Interleaving	Excluded	
Ptime	20	
Channels	1	
max-red	0 (redundancy not used)	This is the maximum duration in milliseconds that elapses between the primary (first) transmission of a frame and any redundant transmission that the sender will use, allowing a receiver to have a bounded delay when redundancy is used; allowed values are between 0 (no redundancy will be used) and 65535. Please note: the parameter is omitted, no limitation on the use of redundancy is present.
Direction Attribute in Initial INVITE	a=sendrecv	The IoT device indicates in the SDP offer in the initial INVITE that the media is sendrecv either by including the "a=sendrecv" attribute or by omitting the direction attribute.

References

The following documents are referenced in this Technical Guideline for VoLTE services on the Telefónica Germany network:

Reference	Description	URL
3GPP TS 23.003	Numbering, Addressing and Identification	https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=729
3GPP TS 23.167	IP Multimedia Subsystem (IMS) Emergency Sessions	https://www.etsi.org/deliver/etsi_ts/123100_123199/123167/
3GPP TS 23.221	Architectural Requirements	https://www.etsi.org/deliver/etsi_ts/123200_123299/123221/
3GPP TS 23.401	General Packet Radio Service (GPRS) Enhancements for E-UTRAN Access	https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=849
3GPP TS 23.402	Architecture Enhancements for non-3GPP Accesses	https://portal.3gpp.org/Specifications.aspx?WiUid=390019&q=1&utm_source=chatgpt.com
3GPP TS 24.167	3GPP IMS Management Object (MO); Stage 3	https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=1047
3GPP TS 24.173	IMS Multimedia Telephony Communication Service and Supplementary Services; Stage 3	https://portal.3gpp.org (search 24.173)
3GPP TS 24.229	IP Multimedia Call Control Protocol based on SIP and SDP; Stage 3	https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=1055
3GPP TS 24.301	Non-Access-Stratum (NAS) Protocol for Evolved Packet System (EPS); Stage 3	https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=1072
3GPP TS 24.341	Support of SMS over IP Networks; Stage 3	https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=1085
3GPP TR 24.930	Internet Protocol (IP) Multimedia Call Control Protocol based on SIP and SDP; Call Flows and Message Sequences	https://portal.3gpp.org (search 24.930)
3GPP TS 26.114	IP Multimedia Subsystem (IMS); Multimedia Telephony; Media Handling and Interaction	https://portal.3gpp.org (search 26.114)
3GPP TS 26.445	Codec for Enhanced Voice Services (EVS); Detailed Algorithmic Description and RTP Payload Format	https://portal.3gpp.org (search 26.445)
IR.51	IMS Roaming and Interworking Guidelines	https://www.gsma.com/newsroom/ (search IR.51)
IR.88	EPS Roaming Guidelines	https://www.gsma.com/newsroom/wp-content/uploads/IR.88-v28.0.pdf
IR.92	IMS Profile for Voice and SMS	https://www.gsma.com/newsroom/wp-content/uploads/IR.92-v20.0.pdf
IR.94	IMS Profile for Conversational Video Service	https://www.gsma.com/newsroom/ (search IR.94)
RFC 3261	SIP: Session Initiation Protocol	https://datatracker.ietf.org/doc/html/rfc3261
RFC 3326	The Reason Header Field for the Session Initiation Protocol (SIP)	https://www.rfc-editor.org/info/rfc3326
RFC 4867	RTP Payload Format and File Storage Format for AMR and AMR-WB Audio Codecs	https://www.rfc-editor.org/info/rfc4867
RFC 5009	Private Header (P-Header) Extension to SIP for Authorization of Early Media	https://www.rfc-editor.org/info/rfc5009

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